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WITH PLATES XII AND XIII

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A manuscript bearing the above title by the author is in progress of publication by the Department of Horticulture of the University of Illinois. Since this publication is meeting with delay and in order to give others the advantages of the investigation, the following summary of the more important results is given here.

Apple blotch is now present in all states south of North Dakota, Minnesota, Wisconsin, Michigan, Lake Erie and New York and east of New Mexico, Colorado and Wyoming excepting Florida. Its present range in the United States apparently has resulted from early distant shipments of infected apple trees from nurseries in the Ozark apple region. The distribution of diseased plants from points west of the Mississippi River has been noted in recent years.

The morphology of the causal organism, *Phyllosticta solitaria* E. & E., presents characters which warrant the placing of the species in the same group with *Phoma uvicola* B. & C., *Phyllosticata paviae* Desm., *Phyllosticta congesta* Heald & Wolf and the imperfect form of *Guignardia vaccinii* Shear, recently named *Phyllostictina vaccinii* Shear (6). In addition to these morphological relationships the similarity in the life histories of these fungi and their behavior in pure culture suggest that the fungus under consideration belongs to the genus Guignardia. *Phyllosticta solitaria* E. & E. agrees perfectly with the characters of Phyllostictina Syd., emend. von Höhnel (5, pp. 93–95), but it can not be placed in this genus since the emended description of Phyllostictina is in disagreement with the type specimen of *Phyllostictina murrayae* Syd. (7), which is the type species of Phyllostictina.[1] It is only fair to state that Dr. C. L. Shear (6), adhering to the view of von Höhnel, has recently regarded *Phyllosticta solitaria* E. & E. as a good Phyllostictina.

The minimum temperature for growth of the organism in culture is between 5° C. and 10° C., the maximum between 30° C. and 35° C. and the

[1] According to Sydow the genus Phyllostictina is characterized by 1-celled, ovate, hyaline spores and a globose pseudo-pycnidium in which the spores are borne endogenously, one in each pseudo-parenchyma cell, and freed by the histolysis of the cell walls. No conidiospores are present. It appears from the study of type material that Sydow's generic description cannot be emended at least not in the sense of von Höhnel. *Phyllostictina murrayae* Syd. and *Phoma uvicola* B. & C. therefore cannot be co-generic.

optimum between 25° C. and 30° C. The organism in culture survives long exposures to temperatures far below 0° C. The optimum temperature for spore germination lies between 25° C. and 30° C.

Growth and the formation of pycnosclerotia in culture occur irrespective of light or darkness. Canker enlargement and the formation of pycnosclerotia may occur in the winter in Illinois during prolonged warm, moist periods; it usually begins, however, early in the spring (Plate XIII, figs. D and G) after having been suspended for the winter (Plate XIII, fig. C). The enlargement of the canker in the spring is accompanied by the formation of true pycnidia. These are also an important source of inoculum. After August only pycnosclerotia are produced on the growing cankers. These produce spores early in the following year although they are not mature until spring. New cankers appear on the new growth in August and at that time bear only pycnosclerotia (Plate XIII, fig. B). Late appearing leaf and fruit lesions, as the result of infections after July and August, bear only pycnosclerotia which either remain sterile or give rise to pycnospores in the following spring. The primary lesions on the fruit and foliage play an important part as sources of inoculum for summer infections. The pycnidia on the fruit which have already functioned during the season "fill up" and become typical pycnosclerotia[2] in the autumn, in which stage they pass the winter.

Natural infections occurred in Illinois during the period of these investigations as early as April and as late as September. Periods of natural infection were carefully determined by bagging experiments (Plate XII, fig. A). Primary infections began in the period between two and three weeks after the blossoms had fallen.

The cankers are probably the exclusive source of primary inoculum. The overwintering pycnosclerotia on the mummied fruit and fallen leaves give rise to pycnospores in the following spring, but the relative importance of these pycnosclerotia as sources of primary inoculum is probably negligible. Many of these overwintering pycnosclerotia become sterile.

The ascigerous stage of the organism has not been discovered although there are reasons to believe that one exists and that it occurs rarely on decaying leaves and mummied fruits in the spring, as one of the final stages of the pycnosclerotium (Plate XII, fig. D) as is the case with *Guignardia vaccinii* Shear, *G. bidwellii* (E.) V. & R. and *G. aesculi* (Pk.) Stewart.

[2] Reddick (The Black Rot Disease of Grapes. Cornell University Agr. Exp. Sta. Bul. 293, 1911) first used the term pycnosclerotium referring to a pycnidium containing a pseudoparenchyma of large cells which gives rise to a perithecium. Since perithecia have never been observed resulting from the differentiation of the pycnosclerotium of *P. solitaria* the word is here used in a slightly different sense from that of Reddick although the form and structure of the fruit is in all respects the same.

There are three distinct types of fruit blotch, these showing differences in the histology of the affected tissues the result of varietal differences of the host rather than distinct strains of the fungus. These have been designated as the fringed, the pitted and the blistered types of apple blotch.

The fungus stimulates the host to excessive hyperplasia and to the formation of absciss layers (Plate XIII, fig. B).

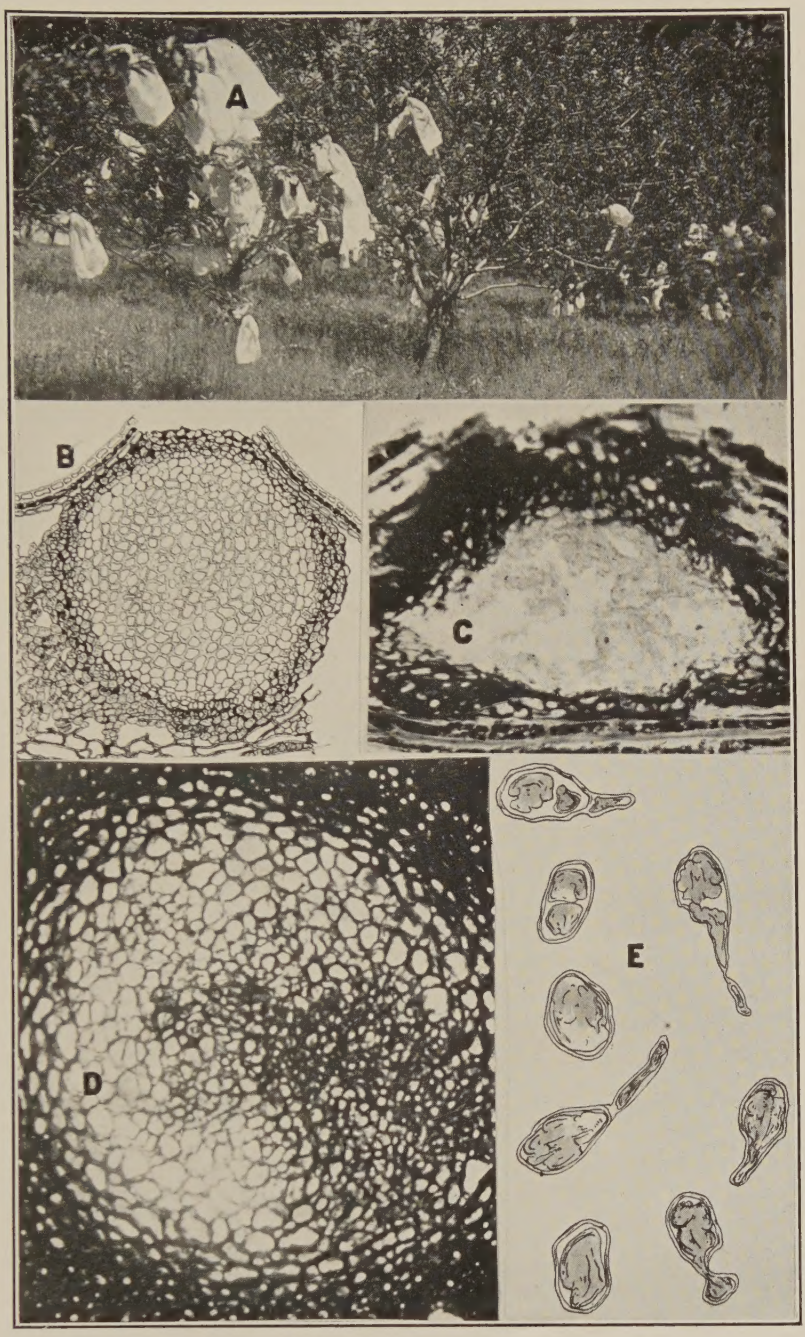
In the bark the cambium is not directly affected. Removal of the fungus by cutting away the canker may therefore be readily accomplished.

The fungus persists in the bark of some varieties indefinitely and in others natural excision occurs within three or four years. Natural excision of the cankers as one means of exterminating or suppressing the fungus as advocated in the early literature is however not dependable.

In the opinion of the writer the removal of the cankers on young trees as recommended by Gardner (1, 2) does not appear to be practicable. Other methods of control have accomplished the same end. These methods consist in the selection and planting of disease free trees, delayed dormant and summer spraying, care in the selection of varieties, avoiding near planting of bark-susceptible with bark-resistant varieties and the natural excision of cankers. Plate XIII, fig. F, shows the typical condition of young bark-susceptible varieties of apple trees in Southern Illinois orchards and Plate XIII, fig. A, the result of an ordinary infection of the fruit. Under these conditions especially canker eradication appears neither practicable, profitable or successfully possible.

The fungus may be partially controlled with late dormant sprays of lime sulfur or copper sulfate at concentrated solutions as reported previously by Guba (3, 4). The affected spores are killed and remain in the dead pycnosclerotia (Plate XII, figs. C and E).

Summer sprays of lime sulfur at two and three weeks and bordeaux mixture at four, six and ten weeks after the fall of the blossoms control the fungus perfectly, although with heavy late seasonal rains an additional spray of bordeaux mixture is necessary in August on late susceptible varieties to insure clean fruit. The first blotch spray or what is frequently termed "the 2 week spray" in southern Illinois must be on the trees not later than 2 weeks after 75 per cent of the blossoms have fallen. Lime sulfur and bordeaux mixture are equally effective as indicated by the unpublished results of the author's experiments. For Duchess and Yellow Transparent apples a 2–3–4–6 week spray schedule is recommended and for the Benoni a 2–3–4–6–8 week schedule. These applications supplement the calyx and earlier sprays, the former application also affecting control of the primary infections which in some years may occur prior to the 2 weeks application.

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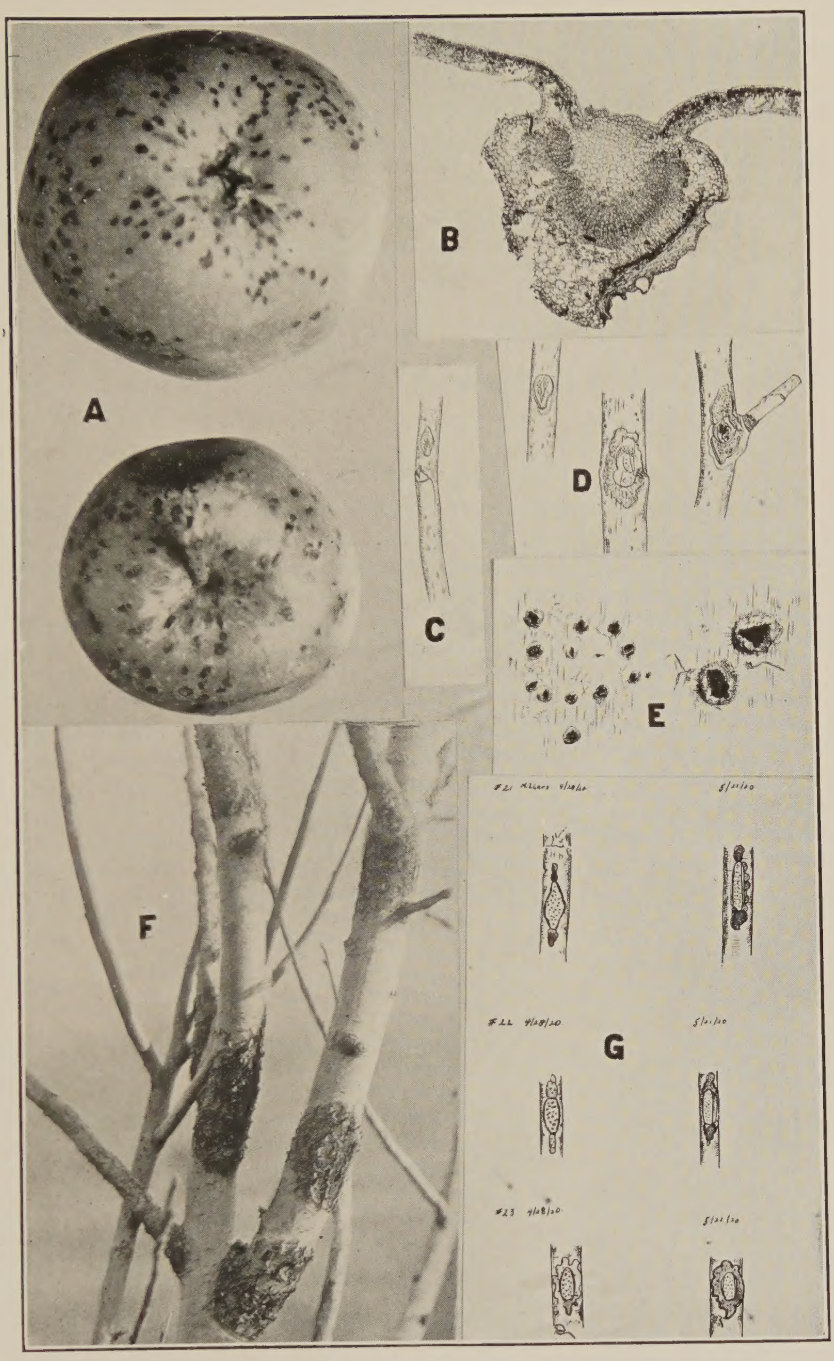


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## EXPLANATION OF PLATES

PLATE XII. Fig. A. Fruit and leaves protected against natural infection in a Duchess orchard. Bagging experiments to determine periods of inoculation. Fig. B. Section through a pycnosclerotium from a canker in December. Fig. C. Section through a pycnosclerotium treated with a late dormant spray of lime sulfur. Fig. D. Section through a pycnosclerotium from a fallen mummied apple in January. Fig. E. Spores from a pycnosclerotium from a canker treated with lime sulfur late in the dormant season.

PLATE XIII. Fig. A. Yellow Transparent apples showing the result of an ordinary infection in Southern Illinois. Fig. B. Section through the midvein of a leaf showing the canker, the abscis layer and the underlying hyperplasia. Fig. C. A canker during the dormant season. This canker resulted from an infection during the previous growing season. Fig. D. Cankers showing the intermittent areas of growth. Fig. E. Exposed pycnosclerotia in the cankers. Fig. F. A 4-year-old Duchess tree, a typical example of young susceptible apple stock in Southern Illinois. Fig. G. Showing the enlargement of the cankers following the dormant season of the host.